

Just beyond the model were three glass cases containing 12 ship models; 6 of obsolete and 6 of types of vessels in the fleet of today. The lesson to be taught here was the effect of a century of progress upon naval shipbuilding and naval technique and placards beside each model explained why various classes of vessels had been rendered obsolete by advances in science and invention and why vessels of up-to-date quality had to be constantly under development. As considerable publicity has attended the opinions of some persons who believe that the Navy might be made up completely of one or two classes of vessels, the placards placed beside the ships of the modern fleet were designed to inform the public of the functions of each class of vessel and the duty each had in producing a well-balanced, modern naval equipment.

As was the case throughout the Navy exhibit, the walls were adorned with paintings and photographs. The two large paintings (Surrender of the German High Seas Fleet and The Arrival of the American Fleet at Scapa Flow) were secured from the committee room of the House Naval Affairs' Committee. There were four lithographs depicting scenes in connection with Perry's arrival in Japan which came from the office of the Major General Commandant of the Marine Corps. Overhead, at the top of the wall space, appeared the first of a series of paintings constituting a frieze which ran throughout the space occupied by the Navy. As was the case with the rest of the items of the exhibit, this frieze bore a lesson—a lesson of sea power and the part it has played in the history of this country from the arrival of sea power in America (the first settlers arriving on the eastern coast) to the present day.

The center of the wall space in this section was occupied by a large mechanical advertising machine loaned by the Poster Brite Co. of Buffalo, N.Y. This was employed to explain the elements of sea power, and, in a sequence of 10 displays, to give an understanding synopsis of the history of great conflicts of the past in which sea power has had a dominant effect. A Gatling gun and an old brass boat howitzer placed in the corners were part of the sequence of the development of modern guns, two examples of which were shown just beyond the cases containing the ship models. The reverse face of the partial wall on the north end of this area was decorated by two paintings showing armed guard actions on the steamers *J. L. Lukenbach* and *Moreni* during the Great War and by a series of photographs of modern vessels of our Navy.

The next two spaces were filled almost exclusively with objects bearing upon ordnance and aviation. The foreground of the first of these sections contained a Browning gun, in the rear of which was a modern 3-inch antiaircraft gun. To the left and on the floor was a mark VIII, model 3 torpedo and to the right a sequence of 6 projectiles ranging from a 3-inch antiaircraft shell to a wooden replica of a modern 16-inch armor-piercing shell. The background contained a model of the North Sea mine barrage, an actual mine, a series of aircraft bombs, and a depth charge.

One purpose of the exhibit in this section was to instruct the public in the character of the two types of weapons which have been in use from time immemorial—the ones which inflict external injury and the ones which penetrate to injure an opponent from within. As the club and the knife were the early examples of these two types, the public

was shown that the same types exist today, coming down to us in the form of the modern torpedo, depth charge, and aircraft bombs of the first class, and the armor-piercing shells of the second. Placards installed beside each object explained its functions and to some degree its capacities. The wall area here was decorated by a painting of The Escape of the Constitution and two others showing scenes in the Battle of Lake Erie.

Two moving-picture machines occupied the foreground of the next section. One showed details of the steps in the building and repair of Navy airplanes and the schooling of aviation personnel, while the other showed scenes in the actual operation of planes and carriers with the fleet.

Beyond the moving-picture machines were three aircraft engines, the first being a model of the first air-cooled engine for airplanes (a Lawrence two-cylinder). The others were modern aircraft engines contributed by the Wright Aeronautical Corporation and the Pratt & Whitney Aircraft Co. These were cut in sections so that visitors might observe their internal operation and, operated at slow speed by electric motors, furnished a valuable and interesting exhibit throughout the Fair. Aviation photographs, a life raft which saved the life of a naval aviator in the waters off Panama and samples of metal propeller blades used on planes and dirigibles were mounted along the wall. Several of the latter were cut into sections for easy examination of their structure. From the ceiling was suspended a model of the dirigible *Macon*, part of its outer skin being rolled back to show its internal structure. Beyond it, but not visible in the photographs, was a small model of a plane.

Between the areas devoted to ordnance and aviation was a stand of illuminated pictures, one side showing scenes of gun firing and torpedo firing at sea and the other scenes in connection with naval aviation. To the right was a glass case containing examples of compasses used in air navigation, a model of a Navy helium car, and models of various types of naval planes.

The center of the floor space allotted to the exhibit of engineering items was occupied by a table display which illustrated steps in the progress of the science of screw propulsion for steamships. The rear wall bore photographs, drawings, and explanatory descriptions of the machinery arrangements of the *New Orleans* and *Saratoga* and a cross-section model of a paddle wheel propelling plant of 1830. This section was partially isolated from the next by 3 small dioramas, the backs of which were employed to display 3 framed placards. The first of these explained some of the contributions of the Navy to the electrical industry; the second contained the statement of United States naval policy, and the third bore a diagram of the United States showing how each State of the Union benefits from naval shipbuilding.

A considerable space was devoted to an explanation of the training and schooling of which the officers and men of the Navy have advantage. Wall photographs and a moving-picture machine in this area showed scenes at the Naval Academy at Annapolis, at a training station, and items of life aboard ship so that the public might understand something of the training that the officers and the men undergo. Here also was another motion-picture machine showing all types of naval ships engaged in tactical and gunnery maneuvers and evolutions.



Similar means were employed to show steps in the development of the naval uniform and to explain some of its features whose origin are generally unknown to the public. Three small dioramas contributed to this display, depicting types of ship construction and uniforms at different periods of our naval history.

There was also in this area an explanation of the functions of the Hydrographic Office, indicating the place of the Navy in the production of charts and the publication of the many aids to mariners by which the air and the oceans are navigated. Samples of Hydrographic Office publications were displayed in 1 of the 2 glass cases seen in the foreground, the other containing examples of the educational courses in the various trades and duties which are made available to the enlisted men. The right-hand side of this space contained a large diorama showing our fleet at sea in battle formation.

At the right-hand end of this section were two Poster Brite machines also loaned by the Poster Brite Co. of Buffalo. These were placed back to back upon a stand. One of these was principally employed to explain to the public the national policies of the country which concern the Navy and to call attention to the fact that national policies are but the mass opinions of the citizens. The other machine displayed quotations from various Presidents of this country who at one time or another have expressed themselves on the need of a Navy and the functions in the life of the Government, which the Navy is expected to execute.

The end of this section was decorated by an excellent knot and splice board furnished by the U.S.S. *Marblehead*. The items of this display were made by two enlisted men of the *Marblehead* under the supervision of a lieutenant, graduate of the Naval Academy, and attracted much attention.

The exhibit of the Marine Corps occupied a triangular space, separated somewhat from the rest of the Navy exhibit by a doorway giving entrance into the building. The commanding items at the north end were a stand of flags, famous in the annals of the Marine Corps, and a case of citations which the corps received during the Great War. To the right was located a model map of the world, showing, by a succession of lights, various places in the world in which marines have been engaged throughout their history. The wall space was decorated with handsome paintings showing scenes famous in Marine Corps history and by a bronze plaque recounting the circumstances under which the Marine Corps was founded and functions as an integral part of the United States Navy.

The frieze mentioned in paragraph 5 above was composed of pictures which bore the following titles:

Jamestown 1607  
 Sea Power Reaches America  
 Early Settlements  
 English Sea Power Predominated  
 Founding of the Navy Department 1798  
 Millions for Defense Not One Cent for Tribute  
 Battle of Lake Champlain 1814  
 Clears Hudson Valley of British Army  
 The Monitor and Merrimac 1862  
 The Union Blockade is Preserved  
 Birth of the New Navy 1883  
 Dolphin Atlanta Boston Chicago  
 Battle of Manila Bay 1898

Dewey Isolates the Philippines  
 First U.S. Naval Forces Arrive in Europe  
 We Are Ready Now Sir  
 The Protector of America's Sea Power  
 The Fleet

#### UNITED STATES NAVY SCIENTIFIC EXHIBITS IN BASIC SCIENCES

One of the exhibits displayed in the great hall of the Hall of Science was a Sperry gyroscopic compass, mark II, model 16.

A control panel, a motor generator, dynamotor, storage batteries, and an alarm indicator were grouped in a booth on the mezzanine of the great hall. This booth was one of five devoted to mathematical exhibits by the Navy.

A repeater compass mounted in gimbals in a pelorus stand was located a few feet east of the control panel booth. Another was located on the main floor near the north octagonal wall near an exhibit "The fixing of a ship's position at sea."

The exhibits of the United States Naval Observatory were on display in the booth adjacent on the north to the booth containing the motor generator for the gyro compass. The central feature was a display of a transmitting clock, a sidereal clock, and the Locke clock with its chronograph. The walls of the booth were used to display photographs and legends explaining the exhibit. A radio receiving set was exhibited for the purpose of receiving time signals.

A miniature time ball was located in the center of the rail around the mezzanine of the great hall.

A glass-covered display case held a selection of octants, sextants, and chronometers loaned to the mathematical section. Publications useful in navigation were also on view.

One of the striking exhibits in the mathematical section was "A developmental history of electro-magnetic wave communication." This consisted of selected developments and discoveries from the integration of the wave equation by D'Alembert in 1747 to the present. The subject matter was presented in free-hand lettering on black panels representing classroom blackboards. Line drawings, diagrams, and sketches were used for illustrations. The subject matter was collected by Lt. Alvin L. Becker, United States Navy, communication officer, Ninth Naval District, and reduced to final form by the mathematical section. The radio apparatus loaned by the Navy was used to illustrate the developmental history. Each piece of apparatus had a descriptive card which connected by a white silk ribbon to the text matter, lettered on the board.

A variable power spotting periscope was mounted on a stand located at the north end of the mezzanine. By means of this arrangement the visitor could look through the periscope and move it in elevation and azimuth. A legend nearby explained the principle and use of the periscope.

A 1½-meter base rangefinder was on display on a terrace built on the mezzanine level. Here the visitor could "range" on many objects in view, including ships passing on Lake Michigan. A legend suspended from the instrument explained the mathematical and optical principles embraced in the design and use of the instrument.



A watch composed of Navy enlisted personnel was maintained in the hours during which the public was admitted to the Hall of Science.

Appropriate lettering in prominent places gave credit to the Navy for its contribution to the mathematical exhibits.

#### NAVY HELIUM CAR IN TRAVEL AND TRANSPORT BUILDING

This car, No. USNX 1006, was loaned by the General American Tank Car Corporation to the Navy Department for display as an example of the latest and most up-to-date equipment in modern freight service. This car was installed on the floor of the Travel and Transportation Building under the dome. Suitable placards were placed identifying the car as Navy property loaned and manufactured by the General American Tank Car Corporation.

### DEPARTMENT OF THE INTERIOR

#### OFFICE OF NATIONAL PARKS, BUILDINGS, AND RESERVATIONS

The Office of National Parks, Buildings, and Reservations, formerly the National Park Service, was represented by three displays. The principal one was that in the Federal building.

The booth in the Federal building was treated in a naturalistic design. At the end of the booth there was a large realistic model of Mount Rainier which was 20 feet wide, 11 feet high, and 8 feet deep. This model contained about 2,000 artificial trees, and modeling of the foreground was blended into the painted background. There was a miniature glacier produced by refrigeration to represent the Nisqually Glacier. This model was also provided with automatic light changes which reproduced the 24 cycles of daylight and night. There were also moving clouds reproduced on the background, and those in charge could turn on at will a snow storm effect which operated for 3 minutes and then returned to the continuous change from daylight to night.

The booth also contained a large United States map showing 38 colored paintings illustrating the most notable parks and monuments. A continuous motion-picture projector furnished movies from many of the national parks and monuments. There was also an exhibit of national-park literature.

Six long benches were provided for visitors, and these proved to be exceedingly popular. The daily attendance within the confines of this booth during the months of July and August averaged 18,000.

The second important display was located in the Hall of Science in which there was a series of dioramas which developed the theme "Earth sciences as exemplified in the national parks." These dioramas were smaller in size, from 5 to 8 feet wide, but they were very well executed and made a pleasing display. Their titles and descriptions follow:

*Bryce Canyon.*—This diorama illustrated the fantastic weathering of the Wasatch formation in southern Utah.

*Petrified Forest.*—This model showed the method of burial of the petrified logs and their subsequent exposure by erosion. A composite view of the Petrified Forest National Monument in Ariz.

*Carlsbad Caverns.*—A typical view of one of the chambers in Carlsbad Caverns National Park, N. Mex.

*Yellowstone Geyser.*—A miniature operating model of Old Faithful Geyser, Yellowstone National Park, Wyo.

*Kilauea Crater.*—A realistic model of the lava crater in Hawaii National Park.

*Ice Caves of Mount Rainier.*—A model showing the fantastic caves formed by melting on the underside of a glacier.

*Grand Canyon.*—A well-executed model of the Canyon view from the Yavapi observation station in Grand Canyon National Park, Ariz.

*Mesa Verde.*—A model of the sandstone cliff and cliff dwellings of Balcony House in Mesa Verde National Park, Colo.

*Grand Tetons.*—A replica of the Alpine type peaks in this famous park.

*Rainbow Bridge.*—A replica of the famous bridge in Rainbow Bridge National Monument, Utah.

*Yosemite Valley.*—This diorama illustrated the famous valley of the Yosemite, and also showed two of the three largest granite monoliths in the world.

In a side booth there was a continuous motion-picture projector in which were shown views from many of the national parks and monuments.

A third display was located in the rotunda of the Federal building which was sponsored by the National Capital Park and Planning Commission, which is now combined with the Office of National Parks, Buildings, and Reservations. This display was composed of two replicas, one of the Capitol and Mall, and the other of the White House. In addition, there were many historic paintings and other historic data relating to the National Capital.

#### BUREAU OF RECLAMATION

This display consisted of three features: (a) Operating model, Boulder Dam and power plant; (b) diorama of Yakima irrigation project, Washington; (c) illuminated map showing location of Federal projects.

*Boulder Dam and power plant.*—The operating model of Boulder Dam and power plant showed this structure as it will appear after completion. The model was 16 feet 6 inches long and 6 feet 6 inches wide, constructed complete in every detail, on a scale of 1 inch to 30 feet, with painted background showing the lake and rugged mountain scenery of the Colorado River Valley. The model was so built as to show the full operation of all portions of the dam. As the water reached the intake towers it began to discharge through the power plant; as the water surface rose back of the dam the outlet valves on the canyon walls began to discharge and continued until the water had risen to the spillways, when the drum gates on the spillway crest were automatically raised and remained so until the water overtopped the gates, when they dropped automatically just before the reservoir water surface reached the top of the dam, releasing a flood corresponding to 200,000 cubic feet per second down each spillway. The water used in the operation of the model was pumped into the reservoir back of the dam by means of an electric motor and centrifugal pump,



the supply of water being held in a small tank underneath the model. This model was built and installed by the engineers of the Denver office of the Bureau of Reclamation.

*The Yakima diorama.*—The diorama showed this project as seen from the north side of the valley looking toward the snow-capped peaks of the Cascade Range, with the five storage reservoirs in the painted background, together with the irrigated sections around Ellensburg, Tieton, and Yakima. The modeled portion of the diorama represented the irrigated area of the southerly portion of the Kittitas division. The diorama was 8 feet wide, with a depth of about 6 feet.

*Illuminated map.*—This map 8 feet square showed the western portion of the United States and the projects that have been built by the Bureau of Reclamation. The map was drawn on translucent material and around the edges were placards showing the name of each project, the irrigated area, the principal crops and average value per acre for the last 10 years. From each placard a line ran to the project described and the electrical apparatus illuminating the map was so arranged that a group of placards and the corresponding projects, there being seven such groups, were lighted one group at a time, and remained illuminated long enough to permit reading the information on the placards.

#### GEOLOGICAL SURVEY

The Geological Survey emphasized in its display the comprehensive nature of its investigations of the geology and mineral resources of the entire United States and the relation of those studies to the development of the resources. Above and across the display was a geologic cross-section of the United States along the thirty-ninth parallel; this showed the earth's surface in profile, and the distribution and structure of the rocks by many colors and patterns. Geographic features and the location of important mineral deposits are indicated. Below the section was a series of five colored and illuminated relief models behind glass windows. Four of these illustrate types of mineral development benefited by Survey work—coal mining, metal mining, oil-field development, and a storage dam and hydroelectric plant. The fifth model shows several Survey geologists and engineers at work in a typical western landscape.

On the opposite wall was displayed a copy of the newly published geologic map of the United States, a composite copy of the modern large-scale typographic map of Chicago and vicinity, and a panel illustrating the several types of publications issued by the Survey.

#### OFFICE OF INDIAN AFFAIRS

The Indian Affairs exhibit occupied a central location near the main entrance of the Federal Building.

The main display was shifted from the Mayan Temple to the Federal Building and was hence not as originally planned. It was a display, principally, of the arts and crafts of the Indian school system. The following schools all contributed materially to the exhibit: Albuquerque, Santa Fe, Haskell Institute, Flandreau, Fort Wingate, and others. The Santa Fe and Albuquerque schools furnished examples of Pueblo pottery, silver work, painting, cooper smithing, woodwork. Fort Wingate furnished some very fine Navajo weaving

and silversmithing. Flandreau contributed examples of iron work, woodwork, beadwork, and application of design to textiles, as did Haskell Institute.

The famous Indian Pueblo artists furnished a series of murals which were hung in the Mayan Temple.

#### OFFICE OF EDUCATION

The Office of Education display was designed to show what a century of progress had meant in education, what might be expected in the future, and the work being done to contribute to this march of education in the United States. This was accomplished first by three large panels, 5 by 6 feet in size, with composite paintings of education—past, present, and future. These were framed in modernistic style with chromium-plated copper and flanked by two large columns carrying bands of red letters indicating some of the chief fields of activity of the Federal Office of Education, such as nursery schools, kindergartens, elementary schools, secondary education, higher education, statistics, surveys, libraries, research.

In front of these panels stood a chromium-plated cabinet on which was mounted a large book with leaves which turned automatically. This was the "talking book", the first device of its kind ever successfully operated over any length of time. The turning leaves contained large illustrations which accompanied the spoken text. The talking mechanism was adjusted so that the text was timed to the turning of the leaves. The talking book told more in detail the services of the Office of Education.

#### GENERAL LAND OFFICE

The General Land Office display consisted of two features:

(a) Wall map of the United States, 11 by 14 feet, which showed the extent and development of the public-land surveys, the territorial acquisitions and insular possessions, the Indian reservations, the national forests, the naval and military reservations, the reclamation projects, the national parks and monuments, the lighthouse and signal-service reservations, the bird reservations, the railroads, the principal cities, and towns, and the usual data, such as is found on a map of this kind;

(b) One glass case, 3 by 5 feet, containing old and modern surveying instruments and corner monuments, and blocks of overgrowth showing marks inscribed on old witness trees. One interesting feature of this display was the contrast between the wooden posts used formerly for marking the corners of the public lands and the modern iron posts now in use.

#### THE TERRITORIES

*Alaska.*—In addition to a large group of miscellaneous articles descriptive of Alaska, the Alaska exhibit was made up of five dioramas that portrayed a number of the scenic features of the Territory and its industries.

All display material was housed in a picturesque log cabin situated east of the Court of States, near the shore of Lake Michigan. The grounds roundabout were landscaped, and at either side of the entrance to the cabin stood a genuine Alaska totem pole. Typical of



an Alaska prospector's cabin, caribou horns were fastened above the entrance, outside.

No. 1 diorama portrayed the dredge gold-mining operations in the Territory; no. 2 diorama, which was chiefly scenic, portrayed the village of Nenana, the Tanana River, and a portion of the Alaska Railroad; diorama no. 3, another scenic, portrayed the "loop" on the Alaska Railroad; no. 4 portrayed Alaska steamship transportation, coastal scenery, fisheries, and the salmon canning industry; and diorama no. 5 described homesteading in Alaska.

Other material used in making the Alaska exhibit consisted of the following: Genuine Eskimo-carved ivory specimens; Indian and Eskimo baskets; Chilkat Indian blankets; Alaska reindeer skins and parkas; prospectors' equipment; totem poles; "potlatch" dishes; mounted seals; an illuminated map showing the locations of the various minerals and mining activities in Alaska; hand-colored pictures; the parka worn by the late Carl Ben Ellson, Alaska's pioneer aviator, in his flight over the North Pole with Sir Hubert Wilkins; Indian and Eskimo fishing and hunting implements; grain samples; and big-game trophies consisting of moose, mountain sheep, mountain goat, and caribou heads.

"Slim" Williams, Alaska "sourdough", reached Chicago the 16th of September, following a 4,600-mile trip from Copper Center Alaska, with his dog team, having left Alaska the 20th of November the year before. He established camp at the Alaska cabin, and his outfit added considerably to the effectiveness of the Alaska exhibit.

Once the exposition was under way, and until "Slim" Williams arrived, the Alaska cabin welcomed an average of approximately 10,000 visitors each day. After Williams' arrival the attendance averaged in the neighborhood of 14,000 visitors daily. Mrs. Dolly O'Keefe, who lived in the northland 17 years—15 years in Dawson, Yukon Territory, and 2 years in Nenana, Alaska—acted as hostess.

*Hawaii*—Hawaii's commercial and cultural progress during the past 100 years furnished the theme for the Territory's display. Carrying out this idea were two large murals, one depicting Hawaii 100 years ago, the other showing a view of Honolulu today. Rounding out the setting for the old Hawaii presentation were numerous island museum objects and the facade of a grass hut, constructed in miniature.

Continuously operating motion pictures and a mechanical device to play Hawaiian music continuously enabled visitors to "tune in" on the music as well as the scenery of the island Territory. Subject matter of the motion pictures included Hawaiian industries, aquatic sports, entertainments, native customs, as well as scenery. Other pictorial presentations of Hawaii were afforded by a photo-display machine that changed views automatically and by a picture-display rack that held 80 enlarged photographs.

Hawaii's climate was advertised by the use of a surfboard model which showed Hawaiian time and recorded the temperature in Honolulu.

Other exhibit material at the Hawaiian booth included Hawaiian leis; a transparent sugar stalk, showing the various stages in sugar refining; kahilis, or royal staffs from the Territorial capitol building; barking sand from Kauai Island; and black sand from Hawaii Island.

Hawaii day was celebrated at the exposition on June 29. On that day 10,000 paper leis were distributed to visitors, Hawaiian musicians serenaded, pineapple juice was served in the Agricultural Building, and in the General Motors auditorium there were performances throughout the day of Hawaiian sound and color motion pictures. The main event was a concert of island music and dancing in the evening, at which time United States Commissioner Harry S. New delivered an address.

*Virgin Islands*.—The display of the Virgin Islands consisted entirely of articles made or manufactured by residents of the islands. The items displayed consisted of linen work, basketry, toys, woodwork, bay rum, and purses and other articles made of native beads. All Virgin Islands articles were displayed on a wall, in front of which was the Department lounge, arranged for the comfort and convenience of visitors. The Virgin Islands display and the lounge occupied center location in the Interior Department's space.

#### HOWARD UNIVERSITY

The feature of the Howard University display consisted of a balopticon made in the form of a booth. The display covered three major fields of reflections on Howard University; namely, yesterday, today, and tomorrow. These were presented in the form of a series consisting of 70 slides that were operated automatically so as to produce a continuous display. In addition to the feature there were specially bound volumes of the university catalogue, and of the Journal of Negro Education; also a specially framed and rare picture of Gen. O. O. Howard, founder of the university. The display was further augmented by diagrammatic figures that represented the various schools and colleges of the university granting degrees. The making of the display was under the direction of the staff of the department of architecture, Howard University.

#### COLUMBIA INSTITUTION FOR THE DEAF

This display consisted of charts showing the organization of the institution, with date of foundation, management, departments, value of buildings and grounds, number of graduates, general description of courses of study, and occupations of graduates.

A series of photographs showed a great many of the buildings, views of grounds, activities of students in studies, athletics, and social life, while others were descriptive of the products of technical work, such as printing, costume designing, etc.

#### ST. ELIZABETHS HOSPITAL

The feature portion of the display of St. Elizabeths Hospital consisted of a glass case containing articles such as needlework, baskets, shoes, toys, etc., made by the patients.

#### DEPARTMENT OF AGRICULTURE

The exhibits prepared and displayed under the direction of the United States Department of Agriculture were situated on the ground floor at the north end of the Federal Building, and occupied approximately 6,500 square feet of floor space.



The display presented a general though limited cross-section view of Department investigative and research activities and services to American agriculture as performed by the 19 units composing the Department organization. Scenic settings, dioramas, light, motion, objects, specimens, maps, and charts were employed and coordinated in an architectural design that was harmonious with the exhibits of the other branches of the Federal Government, to make the display one of dignity, information, and inspiration.

The Department's exhibits presented the activities of the organizations shown in the following list:

1. Agricultural Adjustment Administration.
2. Bureau of Agricultural Economics.
3. Bureau of Agricultural Engineering.
4. Bureau of Animal Industry.
5. Bureau of Biological Survey.
6. Bureau of Chemistry and Soils.
7. Bureau of Dairy Industry.
8. Bureau of Entomology.
9. Bureau of Home Economics.
10. Bureau of Plant Industry.
11. Bureau of Plant Quarantine.
12. Bureau of Public Roads.
13. Extension Service.
14. Food and Drug Administration.
15. Forest Service.
16. Grain Futures Administration.
17. Office of Experiment Stations.
18. Office of Information.
19. Weather Bureau.

#### CENTER FEATURE

In a semicircular alcove, which served also as a conference place where visitors could meet and talk with the attendants in charge of the exhibits, typical activities of the Department were portrayed on a series of panels. These included such subjects as crop and livestock improvement, protection from insect pests and diseases, market information, weather service, highway construction, meat inspection, food and drug inspection, and the conservation of the forests and wild life. An automatic motion picture presented the Department's field of service beneath a statement by the Honorable Henry A. Wallace, Secretary of Agriculture, that "Science has conquered the fear of famine and has created abundance, and now we must learn to live with abundance." Souvenir booklets entitled "Science Serving Agriculture" were given to visitors.

#### INFORMATION, EXTENSION, EXPERIMENT STATIONS

General Department information reaches the public by three main channels: Publications, the press, and the radio. A revolving mechanism supplemented by colored transparencies displayed a selected group of Department publications, with information about how they could be obtained. Another mechanical device, operated by an electrical control button, displayed an extensive collection of newspaper clippings on agricultural subjects which served to illustrate

something of the broad cooperation rendered the Department and the public by newspapers, farm journals, trade publications, and magazines in the distribution of information useful to farmers, housewives, business men, and manufacturers. A small diorama represented a typical home scene, with a radio which told the story of how the Department, through the cooperation of broadcasting stations, is able to utilize this modern means to assist people in solving their farm and home problems.

Extension of agricultural education in cooperation with State agencies reaches directly to the farms, where it is most needed, through the system of county agricultural and home demonstration agents. The activities of this service were related by means of a map and two mechanical books which gave the number and locations of the agricultural and home demonstration agents and volunteer workers in each State, with the number of farm and home demonstrations conducted.

The Department cooperates with the States in agricultural research and experiment under the provisions of three Federal laws, known as the Hatch, Adams, and Purnell Acts. A large United States map showed the locations of all the experiment stations, and a set of transparencies with explanatory signs demonstrated the relative economy of official research and service activities as conducted by the State experiment stations and the United States Department of Agriculture, by which there is constituted a Nation-wide agency for research on problems of agriculture and rural life.

#### GRAIN FUTURES

The Department of Agriculture is charged with the administration of the Grain Futures Act of 1922, and how that responsibility is carried out was illustrated by means of charts and legends showing methods employed for the regulation of trading in grain futures on boards of trade.

#### FOOD AND DRUGS

The Department also is charged with the administration of the Federal Food and Drugs Act, which requires that labels of packages containing food or drugs entering interstate commerce shall not make any untruthful or misleading statements. How the law is administered, and also ways in which the present law falls short of public need, were shown by samples of foods, drugs, and cosmetics, with supporting information regarding the inability of the law to control statements and claims that are made in newspaper and other methods of advertising.

#### HOME ECONOMICS

The home-making phase of modern life was shown by the representation of the front of a dwelling. Through a window could be seen the members of a family working out a family budget; while, through another window, appeared a dining table upon which was a well-balanced meal; and through still another window could be observed the floor plan of a kitchen, with special reference to arrangement of equipment. Colored lines indicated travel between stove, refrigerator, sink, and work table in the preparation, serving, and clearing



up of a meal from a stated menu. The display emphasized the planning of kitchens to save steps.

#### WEATHER

Heat, cold, wind, and rain touch and influence every situation of human society, and probably no part of the Department exhibit held greater interest for visitors than that which had to do with weather. There was a large glass map which was kept current daily and which showed weather conditions in all parts of the United States. Accompanying it was a complete weather map for the whole Northern Hemisphere. Lantern slides illustrated typical services, instruments, and operations in field and central stations. Actual instruments used in the exhibit included a bucket rain gage, a sunshine recorder, a barograph, and mechanical and electrical devices for determining solar radiation, wind velocity and direction, and temperature. The wind and temperature instruments were connected with apparatus on the roof of the Federal Building, which enabled visitors to know the outside weather information by the instruments on the table. The Department frost-warning service to fruit growers was shown by a diorama representing an orchard at night, with orchard heaters aglow to keep the atmospheric temperature above the danger point.

#### CONSERVATION, UTILIZATION, AND CONTROL OF WILD LIFE

Mounted specimens of deer, upland game birds, wild turkey, and migratory birds in representations of natural environment called to attention the general public responsibilities and also the specific responsibilities set up by the Migratory Treaty Act which are administered by the Department of Agriculture in the preservation of this type of natural resource. Scenic settings composed of trees, vegetative cover, and the appearance of water, with background paintings that carried the settings into the fading distance, portrayed the kinds of feeding, resting, and breeding refuges that must be provided if the wild-life resource is to be maintained for posterity. Appropriate signs explained Department cooperation with the States and the results of studies in the rearing of game and fur-bearing animals under both wild and captive conditions and also the diseases of wild life.

#### FORESTRY

Forestry, as it must be practiced to accomplish the greatest good to the greatest number in the long run by providing a continuing resource of timber, grazing, watershed protection, stream-flow control, and public recreation, was illustrated by foregrounds and backgrounds that simulated actual forest conditions. The foreground had a natural accumulation of forest litter or duff which builds the humus of the soil and which, acting like a sponge, holds the rainfall in suspension until the ground soil can absorb it and allow it to trickle through into underground water channels feeding the springs and streams. The background portrayed the varied uses of the forests. "How the forest takes care of the rain" was demonstrated specifically by a working model in which rain fell on two areas, one forested and the other denuded. Underneath, a glass front afforded view of the

soil and showed how the water gets down to the water table. Under the forested part the rainfall seeped slowly through and was stored there to feed springs and streams, thereby insuring a constant water supply for power, irrigation, and domestic uses. Under the denuded portion, however, beating rains had sealed the pores of the soil, and the water ran off quickly, to cause erosion and floods.

The story of the growing and harvesting of timber crops was told by four dioramas which revolved within the trunk of a 6-foot Douglas fir tree. First, there was representation of a mature, virgin forest, with most of the trees ready for cutting; second, the cut-over forest, with carefully selected seed trees left; third, the beginnings of a new forest, dense reproduction filling the open spaces; and fourth, the new forest nearing time for another harvest. A huge stump hollowed out into four lighted compartments contained specimens and models to illustrate some of the research work conducted by the Forest Products Laboratory at Madison, Wis.

#### AGRICULTURAL ECONOMICS AND AGRICULTURAL ADJUSTMENT

The grading, storing, shipping, and marketing of American farm products included the Federal grading of meats in packing plants, was shown by a diorama supplemented by maps, charts, objects, specimens, and illuminated transparencies. The diorama represented the business section and stockyards district of a city with scenes of shipping and marketing operations where the bulk of farm products reach their destination. Grades and standards for butter, cheese, eggs, poultry, beef, lamb, pork, and canned vegetables were shown in a glass case, while charts and maps presented information about the results of economic research in international agriculture, farm finance, price analyses, and land economics.

During the early part of the exposition, an exhibit entitled "The Shadow of the Surplus" gave visitors an interpretation of how the vast surpluses of farm crops for which no markets were available had cast their shadows of depressed prices over the whole United States and brought incalculable distress to American agriculture. Later that exhibit was replaced by one entitled "The New Trail in Agriculture", which explained the wheat-adjustment plan for overcoming the enormous wheat surplus by reducing wheat acreage to the point where production would balance demand.

#### PUBLIC ROADS AND AGRICULTURAL ENGINEERING

Both of these exhibits touched from a different but related viewpoint certain high points in the development of American agriculture and demonstrated how that development was influenced strongly both by the improvement and expansion of roads and by the invention, application, and improvement of farm machinery. The exhibits were shown separately, but their themes were interrelated.

Six dioramas, each coming into view in a consecutive order, and each synchronized with an accompanying map and legend, presented first, the Lancaster Pike with a Conestoga wagon in 1792; second, the race of the Tom Thumb locomotive with a horse in 1830; third, a rural road near a railroad station in 1850; fourth, the bicycling days of 1892; fifth, a State line where a bad road ended and a good



road began; and sixth, a modern four-lane highway. The maps showed the roads that existed in each period down to the present national network of improved or surfaced highways.

Three dioramas portrayed the development of an American farm from an engineering viewpoint. The story began with a log cabin in a clearing surrounded by woods, a hundred years ago, where a hardy but isolated pioneer and his family wrested a meager living from an unwilling nature with only the crudest of implements. Then came invention and improvement in agricultural machinery, expanded fields, increased crops, a graded road by which excess produce could be hauled to a distant market, improvement in general living conditions, better buildings, and closer neighbors. Finally, in the third diorama, was the farm of the present, its waste wet lands reclaimed by drainage, its hillsides protected from erosion by terracing, its fields, now broad and well fenced, capably tilled with suitable machinery; its buildings, a modern house and adequate barns; and all beside a good, year-round highway, a telephone and power line, with an industrial city providing market for grain and livestock in the near background.

#### ENTOMOLOGY—PLANT QUARANTINE

Closely associated and often intermingled are the entomological and plant-quarantine activities of the Department. Wherever insect pests threaten the agricultural prosperity, there must the Department be with assistance in control.

The entomological work was shown by three dioramas: (1) Grasshopper control by means of poisoned bran mash, showing a field of corn, a portion of which had been badly damaged, with hordes of hoppers attacking the remainder of the field. A model grasshopper about 2 feet long, in a glass case, clinging to and in the act of devouring a representation of a corn leaf, gave vivid information on how grasshoppers destroy vegetation; (2) control of cotton bollweevil by dusting cotton plants with calcium arsenate. This scene showed two portions of a cotton field. One had been dusted and yielded a net profit at the rate of \$11.32 per bale. The other had not been dusted and yielded a net profit of only \$1.91 per bale; (3) control of codling moth on apple trees. Sprayed trees yielded normal crop, while unsprayed trees produced only a small total yield, with a large percentage of culls.

How the Department, through its plant-quarantine work, prevents the spread of injurious pests, how it eradicates them, and how it excludes new and foreign pests from entrance into the United States, were told in a series of five stories, the outstanding one of which was the narrative of the Mediterranean fruit-fly campaign in Florida during 1929 and 1930. Scores of tiny electric bulbs on a map, synchronized with a series of legends, lighted the area of the spreading infestation, then faded as control became effective and eradication finally became complete. The stories of the Department campaigns against the gypsy moth, the pink cotton bollworm, and the Japanese beetle were presented by other electrical and mechanical devices.

#### PLANT INDUSTRY

The Department of Agriculture has aided farmers through the introduction, development, and improvement of varieties of grains, fruits, and other crops, and this was shown by a series of displays containing actual specimens or realistic models. These included classes and varieties of wheat, cotton, corn, apples, peaches, and berries. There was information on the control of pests and diseases by the growing of resistant varieties, as well as by spraying and dusting. The preparation of oranges for market with special reference to contrast in appearance between the fruit when picked and when packed attractively for market formed a portion of the plant-industry exhibit, as did also a set of models of the principal varieties of apples grown commercially and certain special specimens of cotton and sugarcane.

#### CHEMISTRY AND SOILS

The work of soil survey by which eventually all the soil types of the United States will be classified, the prevention and control of soil erosion; fertilizer investigations, industrial utilization of agricultural byproducts and waste, and the prevention of fires on farms and dust explosions in industrial plants constituted the theme of this section. What can be done with corn cobs was shown from a chemical viewpoint, the three main products of corn cobs being cellulose, lignin, and hemicellulose. Other results of chemical research were illustrated by samples of derris root with insecticides derived from it, foods and other articles made from oranges and grapefruit, and many wellknown items of economic importance from cotton. A series of lantern slides had to do with the production of naval stores and a large glass case contained a model of an ammonia plant for the manufacture of fertilizer.

#### DAIRY INDUSTRY

Panels portrayed the results of studies showing that the ability of a dairy cow to produce milk is inherited from both her sire and her dam. There was an illustration of how the mammary gland develops, and a portrayal of milk secretion. Another display explained how the natural color of butter depends on carotin received by cows in their feed. A map indicated by shaded circles of different sizes the distribution of dairy cattle in the United States, and a statement showed that the average annual butterfat production by dairy cows in this country had increased from 125 pounds to 180 pounds in the last 25 years. Typical markings and colorings of the principal dairy breeds were shown on a model of a cow by means of projected lights. A glass case contained objects and information illustrative of the technical advances in the manufacture of ice cream, Swiss and Roquefort cheese, milk powder, casein, and other dairy products.

#### ANIMAL INDUSTRY

The high standard of excellence that has been achieved by the livestock industry through the application of scientific methods was pictured by a large diorama in which appeared a modern livestock



farm. Arrangement of the buildings, fields, pastures, fences, feeding equipment, and the other appurtenances of a successful livestock farm set forth the plan and operating system of the enterprise.

Supplementing the livestock-farm diorama were maps showing the current status of the Nation-wide campaign for the eradication of bovine tuberculosis and cattle ticks. A glass case contained equipment used in treatment for the prevention of hog cholera; another, samples of wool and mohair with articles manufactured from them. A circular glass-top stand showed 12 specimens of animal parasites and directed the attention of livestock owners to the periods in which the parasites should be looked for and how to combat them. An item pointed out that the production of eggs in the United States has increased from 4,845,000,000 in 1880 to 31,741,000,000 in 1930, a period of 50 years.

#### LIVESTOCK AND MEAT

In cooperation with the Committee on Livestock and Meat Exhibit at a Century of Progress, the department participated in a livestock and meat display in the Foods and Agricultural Building by sponsoring the following three dioramas:

A cowboy sitting on his horse in a range scene at the foothills of the Rockies, as a white-faced herd wends its way to new pastures.

"Livestock in the Feedlot", where steers and hogs are finished for market, showing the barns, silos, and sheds commonly a part of any big feeding establishment. In the rear a livestock truck and a moving train of livestock cars exhibited the means of transporting animals from the feedlot to markets.

The third diorama portrayed the forms of modern transportation used in the meat industry.

A display illustrating preparation of meat for the table was also provided by the Department and consisted of models of roasts of beef shown as when cooked to different stages of "doneness." The weight of the meat when going into the oven was given, the weight on coming out of the oven, temperature at which cooked, and percentage of shrinkage. There was the well-cooked roast, showing a high percentage of shrinkage, and the roast seared on the outside at a high oven temperature and rare inside, which shrank less.

Another display consisted of models of cooked meats, with vegetables and fruits ready for the table. It included 15 combination dishes in which meat was the principal ingredient. Back of this, colored stereopticon slides showed various meats in process of cooking by different methods.

In a modern refrigerator case, the Department displayed wax models of cuts of beef, pork, and lamb chops, rolls, steaks, and roasts. In still another case were displayed models of sausage, including fresh pork sausage, stuffed and in patties; bologna, blood sausage, franks, liver sausage, tongue loaf, veal loaf, and many other sausages and meat specialties. Back of these cases were Government wholesale-cut charts of beef, pork, and lamb.

#### DAIRY COOPERATIVE EXHIBITS

The Department's contribution to the cooperative dairy exhibits displayed in the Dairy Industries Building consisted of a large map of the United States showing the extent of the dairy industry by

States, with stereopticon slides telling about the "Utilization of Milk by States."

Another exhibit, entitled "Dairy Products Lead in the Well-Balanced Diet", illustrated a liberal low-cost diet for a family of 5 for 1 week, 2 adults and 3 children under 15 years.

Two sections of the exhibit Milk Production in the United States were supplied by the Department. In the center section was shown the "mechanical cow." The inside of this cow demonstrated the process of making milk, the stomach, intestines, udder, heart, etc., being pictured as part of a milk factory. The various organs, as well as their functions, were compared to similar machines in a manufacturing plant. The right section, entitled "Progress in Milk Production" pointed out that the cow in her natural wild state produced barely enough milk to support her calf, while the improved cow produces enough milk for 1 calf, 4 adults, and 6 children, more than 8,500 quarts per year.

#### BIOLOGY COOPERATIVE EXHIBITS

These exhibits displayed in cooperation with the biology section of A Century of Progress occupied approximately 1,854 square feet of floor space in the Hall of Science, and consisted in part of material on the following subjects:

"A Growing Twig", which was a large model at the southeastern end of the Great Room and demonstrated by means of mechanical apparatus operated by a control button, the manner of growth in diameter by a 3-year-old twig of basswood or linden (*Tilia*).

"Termite Societies" or white ants, showed by means of models and illustrations how these destructive competitors of man live and work.

"Water and the plant".—This exhibit emphasized the quantity of water used by each plant. In addition to that which passes through the plant during growth, there is a considerable amount which goes to make up the large water content of the plant.

"Flowers and fruits".—The left panel showed a typical complete flower (a wild rose) with certain variations in flower parts which may occur. The large central panel was a mechanical demonstration of pollination and fertilization. The right panel showed various types of fruits and seeds developed from the flower after fertilization.

"Stems and stem activities".—This was a large diagrammatic model of a sectional trunk with roots indicating the use of the stem in supporting the leaves and showing how its cells become a highway or transport system for fluids of the plant. Fluids in glass tubing imbedded in the trunk, represented the direction of flow of the tree's fluids.

"Roots and root activities".—Two large central models showed enlarged root sections cut both lengthwise and crossways. This exhibit dealt with various types of roots, their adaptation to soil types, and their activity as correlated with the physiology of the plant as a whole.

"Leaf activities", consisting of four units, was designed to represent magnification as well as to clear up the general misconceptions concerning respiration and foodmaking in the plant.



"Bollweevil".—This exhibit demonstrated the spread of the cotton bollweevil. It also revealed the weevil's life history and the manner in which cotton is damaged.

"Conservation of wild life" was the subject of the Department's cooperation with the Izaak Walton League, consisting of two dioramas in the Hall of Science:

- (a) Upland game bird management,
- (b) Elk refuge.

These two dioramas illustrated the application of studies of animal behavior and the environment to practical problems.

"How home economics adjusted the home to a century of progress through research and teaching" was still another Department contribution to the Hall of Social Science.

#### DEPARTMENT OF COMMERCE

The Department of Commerce exhibits occupied one side of the south wing of the Federal Building in approximately 6,300 square feet of floor space. In addition, a small alcove in the rotunda, or main entrance to the building, was assigned to the Department, and in this space were shown a model of the Department of Commerce Building at Washington, and on the walls back of the case containing it an enlarged colored replica of the departmental official seal, together with the seals or insignia of its 10 major divisions, named below in the order of placement of their exhibits in the north wing:

Lighthouse Service.

Bureau of the Census.

Bureau of Fisheries.

Bureau of Mines.

Bureau of Navigation and Steamboat Inspection.

Patent Office.

Bureau of Foreign and Domestic Commerce.

Aeronautics Branch.

Coast and Geodetic Survey.

Bureau of Standards.

#### LIGHTHOUSE SERVICE

This exhibit illustrated the work of the Lighthouse Service in supplying water-borne commerce with the aids necessary for safe and economical navigation, and in protecting lives and property from the perils of the sea. Some of the equipment on display, in use in earlier years, by comparison with modern equipment showed a century of progress in lighthouse engineering. Illustrating the general scope of the activities of the Service was a large map showing district boundaries, principal lighthouses, lightships, local offices, and supply depots, not only in continental United States but in Alaska, the Hawaiian Islands, and Puerto Rico.

The navigational aids necessary for a typical important seaport were shown by means of a diorama having models of lighthouses, lighted buoys, and a lightship as used in marking the entrance to a harbor and the channels leading to its wharves. The aids were lighted and properly colored and displayed flashing characteristics as actually

used in practice for identification purposes. The diorama was electrically operated and showed both daylight and night conditions.

A series of lenses depicted the progress in optics during the last century as adapted to lighthouse purposes. A small, crude, bullseye lens which might be held in the hand was the earliest type, and contrasts strongly with the great Fresnel lens which was once used for the light at Navesink, N.J. Other lenses, intermediate in size and of various designs, illustrated the many types required, and specimens of modern flashing mechanisms in actual operation showed the manner in which the flashing lights are produced. The various types of illuminant which have been used for lighthouse purposes were also included. Early oil-wick lamps, the more recent incandescent oil-vapor lamps, and modern acetylene and electric lights, each shown in various sizes, formed an interesting series.

Models of several noteworthy lighthouses were also displayed. That of Tillamook Rock Lighthouse, Oreg., indicated the engineering difficulties encountered in constructing a lighthouse on a wave-swept pinnacle of rock, while the model of Kilauea Point, Hawaii, showed a lighthouse on a site considerably above the level of the sea. Small models, constructed to scale, illustrated typical automatic acetylene lights, one on a fixed structure on shore, and the other on a buoy floating in the water.

Two types of fog signal were included in the exhibit, one completely equipped with timing devices as were the most modern fog signals, the radiobeacon transmitter, as installed at lighthouses and on lightships, together with its counterpart, a small type direction finder, by means of which navigators are able to receive the radiobeacon signals transmitted. An illuminated map of the Great Lakes showed the radiobeacon system in operation. On it each radiobeacon was represented by a small flashing light. Each light flashed the signal of the station it represented and electrical control operated the lights in groups and at the regular intervals, closely simulating the operation of the stations in actual service.

There were also numerous photographs of typical and well-known lighthouses and lightships on all parts of the coast, and a display of the publications of the Service.

#### BUREAU OF THE CENSUS

The Census Bureau, which was established in 1790, collects, compiles, and distributes statistics. The main feature of its exhibit was an electrical chart showing at prescribed intervals, by means of colored lights, changes in the population due to births, deaths, immigration, or emigration. On top of this chart was an integrating counter reflecting these changes so that the exact estimated population of continental United States was shown up to the minute.

On the wall space and supplementing the large electrical chart were 10 statistical graphs or charts showing census trends in various fields, entitled, "Color and Nativity of the Population, 1930"; "Wholesale Trade by Type of Establishments"; "Cotton Production, Consumption, and Spindles"; "Preventive Medicine Has Decreased Deaths Due to Specified Causes"; "Per Capita Revenue Receipts, Government Costs, and Net Debts by States, 1931"; "Farms, Acreage, Value of Land and Buildings, and Value of Products, Census of 1930,



also Farm and Population Movements"; "Median Value of Owned Farm Homes, by States, 1930"; "Retail Sales by States, 1929"; "Type of Farming Areas in the United States, 1930"; and "The Concentration of Industrial Workers, 1929."

Another feature of the exhibit of especial interest to the visitors was the collection of original census returns of many outstanding citizens, in particular, those of George Washington and Abraham Lincoln, for certain years, showing personal and family data. In like manner a record of every inhabitant of the United States is filed by the Bureau of the Census. These records are used for the establishment of ages, nationalities, residences, relationships, etc.

The 1930 decennial census covered the subjects of population, manufactures, mines, and quarries, agriculture, horticulture, irrigation, drainage, and distribution (including wholesale and retail trade, the construction industry, and hotels). This was the most detailed census ever taken in this or any other country. At 5-year intervals the Bureau takes a census of agriculture, and at 2-year intervals a census of manufactures. During intercensal periods this Bureau collects statistics concerning mortality and births, financial data for States and cities, electrical industries, religious bodies, water transportation, institutional population, and current industries, such as cotton, animal and vegetable fats and oils, automobile production, wheat, wool, steel, and other leading commodities. Punching, sorting, and tabulating equipment such as that used for the tabulation of these census data were shown. The gang punch, sorter, and tabulator on exhibition represented types of equipment manufactured in the mechanical laboratory of the Bureau of the Census; the key punch used for punching tabulation cards was a model of one modified in the laboratory to meet census requirements. There were also on exhibit copies of printed reports on all subjects covered by the census.

#### BUREAU OF FISHERIES

Featuring the Bureau's exhibit were three large paintings entitled: "Nature's Creations", "Man's Despoliation", and "Science's Restoration", in front of which were placed a rock garden and pool, with a working model of a fish ladder on one side and a model of a fish lock, or elevator, on the other. Water running from the two models flowed into a central pool containing a variety of fish and aquatic plants.

In two aquaria various species of fish propagated by the Bureau at its hatcheries were displayed. An exhibit of packaged quick-frozen fish and shellfish in a refrigerated case was made possible through the cooperation of several firms which prepare these products.

Four centrally located cases, with displays on two sides, contained three dioramas depicting, respectively, a trout hatchery, modern oyster culture, and the nutritive value of marine products. The fresh-water mussel fishery and industry, oyster propagation and seed collection, and a display of packaged fish, with charts indicating the vitamin content of various fish oils and the amount of iodine in certain fish, were exhibited on the other side of the cases. Models of a Great Lakes pound net and a gill net, with illustrations of the method of fishing with these nets and the method of determining the age of different species of fish from their scales, filled the fourth case, on the

other side of which was a graphic presentation of the Bureau's research on the preservation of fish nets.

A painting entitled "The Angler" was placed between two cases containing exhibits of fishing tackle suitable for salt-water, surf, bass, and trout fishing—supplied by various manufacturers of fishing tackle. Above this group were nine transparencies illustrating the different hatcheries of the Bureau and showing views of oyster culture.

The story of the utilization of fishery byproducts 100 years ago and at present, dyed and dressed sealskins and illustrations of the beneficial effect of the North Pacific Seal Treaty on the Pribilof seal herd, and a résumé of the biological fishery research work of the Bureau, especially as to methods used in deep-sea investigations, fish tagging, and in the study of the composition of the mackerel catch for the last 10 years—displayed in three large cases—with transparencies depicting different activities of the Bureau placed above them, completed the Bureau's exhibit in the Government Building.

Because of the proximity of the very fine collection of live fish in the Shedd Aquarium, the Bureau made no attempt in that field.

In the Hall of Science the Bureau exhibited two transparency panels, 7 feet high and 9 feet long, depicting the life history and migration of red salmon and eels. The panel showing the migration of salmon portrayed a section of the Alaska Peninsular in the vicinity of Chignik Bay seen from an elevation of several thousand feet. The spawning run of mature fish and seaward migration of young were indicated by illuminated figures moving on the transparent painting. The migration of eels was shown on a decorative chart representing the North Atlantic Ocean. The panel depicted in a dynamic way the spawning migrations of American and European eels toward the area around Bermuda Islands and the return of young fish to their respective habitats.

The illusion of motion was produced on both panels by means of specially constructed intricate mechanisms projecting the figures of fish from behind and the story enhanced by graphically completing the entire cycle in 75 seconds.

#### BUREAU OF MINES

Various phases of the work by the Bureau were depicted by displays in 12 especially constructed cases. Included were a model of the Bureau's experimental mine at Bruceton, Pa., with equipment actually used in the mine to test the explosibility of gas and coal dust; a life-sized working model electrically demonstrating the correct method of administering artificial respiration; six murals illustrative of petroleum production, metallurgy, safety, metal mining, technical research, and coal mining; and two motion pictures continuously displaying films, produced under the Bureau's supervision, showing the different phases of the mineral and allied industries.

The display devoted to mining methods included a model illustrating various types of metal mining, photographs of mining operations, and samples of ores. The geophysical section consisted of an operating model and descriptive matter illustrating the use of electricity in detecting metallic ore bodies below the surface of the ground. Operating models of a flotation machine and a magnetic separator



with flow sheets illustrating their use in ore concentration also were shown.

The potash exhibit comprised a map indicating sources of potash in the United States, with samples of raw materials; two flow sheets illustrating methods developed by the Bureau for potash recovery, with samples of raw materials and products; and drill core obtained during the Bureau's investigation of potash resources in New Mexico and Texas.

The economic phase of the Bureau's work was illustrated by a map of the United States carrying colored diagrams showing the principal mineral production of each State and specimens of various minerals.

The display of explosives included models of testing equipment used by the Bureau, dummy samples of explosives approved by the Bureau for use in gaseous or dusty coal mines, and a model showing the correct method of charging a hole.

A photograph of one of the Bureau's mine-rescue cars, samples of equipment used in rescue and recovery efforts after mine disasters, and figures illustrating various methods of bandaging in first-aid treatment were included in the safety, first-aid, and health exhibits.

The helium display contained a model of the Bureau of Mines helium-recovery plant at Amarillo, Tex., with an illuminated sign consisting of tubes filled with helium gas.

The petroleum exhibit consisted of a "bubble" tower used in experimental work on fractionation of petroleum, samples of products obtained in petroleum refining, and a chart showing the variety of products ultimately derived from petroleum. A model of apparatus for carbonization and distillation of coal, and photographs and slides illustrative of photomicrographic study of the constitution of coal depicted the Bureau's activities in coal research; while a map of the District of Columbia indicating points at which fuel is delivered, models of delivery trucks, and photographs of the coal-handling plant made up the exhibit of the Government fuel yards.

In addition to this exhibit in the Federal Building, the Bureau maintained one of its mine-rescue cars, fully equipped on a track near the Transportation Building.

#### BUREAU OF NAVIGATION AND STEAMBOAT INSPECTION

Two exhibits were prepared by this Bureau, one located in the Federal Building, and one in the rotunda of the Travel and Transport Building. Both were made possible by the cooperation of manufacturers, who loaned to the Bureau marine equipment, models, and material for the period of the exhibition.

The exhibit in the Federal Building was planned to illustrate the activities of the Bureau, and included:

1. Inspected and approved life preservers, with instructions for their use, a water light, life float, and model of a Jacob's ladder, all displayed so that they could be handled by visitors.
2. Models of modern lifeboats and launching equipment.
3. Various types of portable fire extinguishers, approved by the Bureau, for use on shipboard.
4. Samples of defective materials discovered by steamboat inspectors while making periodic surveys.

5. A model of an American combination passenger and cargo steamer in the foreign trade, showing the load line marks required by law.

6. A cube of 100 cubic-foot volume (illustrating a measurement ton—the legal standard of ship measurement), flanked on each side by three glass cubes to scale, each filled with some commodity such as cotton or coal, with explanations why the official tonnage of the vessel is not the measure of the avoirdupois tons she will carry.

7. Replicas of ship papers (registry certificates, load-line certificate and other documents) photographs of marine disasters and graphs of various marine statistics, shown on a vertical rotary set of display leaves.

The exhibit in the Travel and Transport Building was designed to show advancements during the past 100 years resulting in safer operation of American vessels and improvement of living quarters of American crews aboard ship, and included:

1. Substantially accurate replica of a pilothouse of a modern American ocean liner (steamship *Santa Rosa*) in which were installed duplicates of the navigating equipment and framed replicas of all instructions, certificates and licenses required by law posted in their proper places. A label on each device gave its name and a brief explanation of its functions. A uniformed attendant thoroughly conversant with actual ocean navigation was assigned to the exhibit to answer the many questions of the visitors. A placard describing the equipment of a pilot house of 100 years ago was posted in a conspicuous place.

2. A replica of part of a forecabin of a wooden sailing vessel of 100 years ago, showing the bunks and generally unclean, cramped quarters. A suitable placard described the life of a sailor of those times.

3. A replica of part of the crew's quarters in a modern merchant ship showing the clean, airy, and comfortable quarters fitted with sanitary berths, steel lockers, chairs, and desks. A placard described the important features of a modern sailor's living conditions.

The following firms cooperated with the Bureau by loaning apparatus for exhibition purposes:

#### FEDERAL BUILDING

American Mail Line.  
American La France & Foamite Industries, Inc.  
Armstrong Cork Co.  
Atlantic-Pacific Manufacturing Corporation.  
Welin Davit & Boat Corporation.

#### TRAVEL AND TRANSPORT BUILDING

American Engineering Corporation.  
Chas. Cory Corporation.  
Chelsea Clock Co.  
Lovell-Dressel Co., Inc.  
Radiomarine Corporation of America.  
Sperry Gyroscope Co., Ltd.  
Submarine Signal Co.  
Walter Kidde & Co., Inc.  
Western Electric Co.



## PATENT OFFICE

The exhibit brings to the attention of the public the general nature of the work of the Patent Office, one part thereof showing what is filed by the inventor and the form in which the patent is issued. There are all the plant patents issued by the Patent Office to the date of the opening of the exposition, many of these being in colors. The nature of the information necessary to be filed in the Patent Office on making an application for patent on a plant, and the nature of the grant and the form of the illustration accompanying the grant, are shown in this exhibit.

There are also a number of patents which have had a marked effect on the development of the industries of the country during the last 100 years, each one illustrated by an enlarged drawing with a legend outlining the nature of the device. Among these interesting patents was one granted by the Colony of Massachusetts in 1646, and while this patent was not granted by the United States, it is historically interesting as showing that the colonists had an appreciation of the merits of the patent system. Another is the patent granted to Eli Whitney on March 14, 1794, for the cotton gin. The development of this suggestion alone has made possible the great growth in the cotton industries. Another is the patent to C. H. McCormick for the reaping machine, granted June 31, 1834. The grant of this patent abolished hand labor in the fields and made possible the great grain farms of the western country. Another interesting patent is the patent to Gildden for barbed wire, No. 157124, issued November 24, 1874, for constructing fences. This provided a cheap and effective fence, not only for pastures but for other purposes.

A number of models of general scientific and historical interest were displayed in cases, these models being relics of the early practice under which the applicant for a patent was required to file a model as well as a drawing of his device. Among these which may be mentioned is an air engine, no. 14690, issued to John Ericsson on April 15, 1856. Mr. Ericsson invented a number of important things and this patent illustrates his effort to solve the problem of operating an engine without the use of steam. That Mr. Ericsson was interested in the steam engine is shown by the model of Patent No. 4317 granted December 20, 1845, showing a compound steam engine invented by him. The patent to G. M. Phelps, no. 196476, October 23, 1877, illustrates the efforts of one of those other than Edison to solve the problem of printing-telegraph. The patent to D. Hess, no. 29077, July 10, 1860, for a carpet sweeper, and the patent to W. Weaver, no. 54797, May 15, 1866, for a cherry stoner, show that efforts at that time were being made to lighten household duties. The models of the patents to R. Kitson, no. 11865, October 31, 1854, for cotton picker, and to H. F. Shaw et al., no. 200413, February 19, 1878, for side-hill plow, are illustrative of the efforts to improve the devices used by the farmer. The patent to W. A. Wood, no. 251986, January 3, 1882, and the patent to J. S. Davis, no. 275330, April 3, 1883, illustrate advances in the harvester and grain binder.

While a number of these devices may seem very crude, still they were the beginning of a number of the important machines in use at the present time, all of which have lightened the labors of the workmen in the fields to which the devices apply.

## FOREIGN AND DOMESTIC COMMERCE

The exhibit depicted some of the services and informational activities of this Bureau, its relation to industry and to foreign and domestic commerce. It was planned to show types of economic data which are collected and interpreted as aids to American trade at home and abroad.

A series of eight panels was devoted to domestic trade. The collection, coordination, analysis, and distribution of business facts for the easy and effective use of producers and distributors, what people buy in certain retail stores; what statistical data show the merchant the size and extent of his market; what practice has proved to be a model store lay-out; and how merchants' profits are affected by the conditions of retail sales and collections, were presented in these charts, the main panels of which were designed to call attention to the problems, and the supplemental panels to indicate publications of the Bureau wherein the subjects are discussed.

The feature display was a map of the United States on plate glass, upon which was shown by automatic lighting the captions of the average daily exports over a 10-year period of 10 major commodities or groups of products; i.e., cotton, automobiles, iron and steel, forest products, etc. As the caption showing the data for a commodity was illuminated the States producing the major proportion (a total of 90 percent or more) were lighted.

Four panels called attention to the Commerce Year Book, Statistical Abstract and Survey of Current Business. World supply and demand of silver and the production, flow, and consumption of this metal were shown graphically on one chart. Another panel indicated in broad terms commodity services available for studying and holding the export market.

By the reproduction of a trade list of dealers, a World Trade Report, and photographs of the exterior and interior of merchandising establishments, how the exporter and importer are brought together by commercial intelligence information was shown graphically. While on another chart typical sources of legal and tariff data were indicated.

The remaining five panels were devoted to general types of economic information: The distribution of exports and imports continentally for three periods in the last hundred years; the relative growth of exports of manufactured articles, 1833 to 1933; the relative decline in imports of manufactured articles, 1833 to 1933; and the continental distribution of water-borne exports with a graphic presentation of the rank of 25 leading ports in this movement.

Mainly by means of flyleaves of publications reproduced on supplemental panels, sources of detail information and types of services presented by the graphic or descriptive charts were brought to the attention of the visitor.

## AERONAUTICS BRANCH

The exhibit of the Aeronautics Branch demonstrated pictorially and by means of working equipment, the services this branch performs in connection with regulation and promotion of air commerce, and in the provision of aids to air navigation. It also showed the



expansion of scheduled air-transport routes, and the evolution of aircraft since the time of the first flight in a powered heavier-than-air craft.

Actual demonstrations of the services available to airmen using the Federal Airways System were given by a teletypewriter, an airways rotating beacon, code beacons, a radio receiver, and radio range demonstrator.

The teletypewriter, connected with airways teletypewriter circuits coming into the Aeronautics Branch station at Chicago municipal airport, was in continual operation. Observers saw weather data and other information actually being transmitted along the airways circuits. Weather maps for the eastern and central sections of the United States received on this machine giving current data as to weather conditions in these areas were posted on a display board and copies given to visitors.

One of the high lights of the exhibit was the 36-inch double-ended rotating beacon of the type used on airways, controlled by means of an electric eye worked by visitors. On the top of the beacon platform were two lights of the type which point forward and backward along an airway course to indicate its direction, the cover glasses of the lights being green to indicate a Department of Commerce intermediate landing field.

Two airways code beacons, one green and the other red, placed at the front ends of the exhibit, showed the type of lights used to mark special features of terrain along an airway, or to augment the principal airway beacons in other ways. The beacon with the green lens showed the presence of landing facilities and the red lens their absence.

On the south side were located a radio receiver and a radio range demonstrator. By means of the radio receiver actual airways weather broadcasts to airmen in flight and the radio range signals which guide airmen along their courses could be heard.

The range demonstrator was so arranged that the signals transmitted by both the aural and visual type range beacons were received. By working a switch, the aural signals were brought in through a loud speaker, while the visual indications registered on a dial when a small airplane was moved to the right or left of a range course shown on a map in front of the demonstrator.

In a central location against the rear wall was a large animated electric air transportation map. By means of moving ribbons of light this map showed the yearly expansion of air transport routes in the United States from 1924 to the present time.

On one side of this map was a colored poster depicting the activities of the Aeronautics Branch, on the other the display board for airways weather maps, weather forecasts, and other information received on the teletypewriter machine.

Two cases containing 31 model airplanes were placed on the front, and in line with the rotating beacon light. Historical and modern airplane models ranging from that of the first Wright plane to those of the present day transports were included.

#### COAST AND GEODETIC SURVEY

To those interested in the sea, either from the viewpoint of pleasure or commerce, the importance of having a complete and full knowledge of the coast, its nature, form the location of reefs, shoals, and other

dangers, the daily rise of the tide, the strength of its currents, and other information is fully recognized. The Coast and Geodetic Survey supplies this knowledge, and the purpose of its exhibit was to depict for the observation of the general public some of its varied and complex activities.

The main feature consisted of a model in miniature of an ideal coastal scene, with trees, vegetation, roads, village, railroad, docks, wharfs, breakwater, and lighthouses. On this were shown field parties engaged on geodetic control surveying, such as erecting triangulation towers, making base-line measurements, and obtaining elevations above sea level; topographic parties mapping the shore line; current party making current observations aboard a launch; recording of tides, hydrographic launch for measuring depths and dangers along the shore, showing the use of the leadline for sounding in moderate depths; wire drag operations for locating hidden dangers; hydrographic signals for determining a survey vessel's position; buoy signals for extending control beyond visibility of shore signals; station ships equipped with radio and under-water sound receivers for use in radio-acoustic ranging, a new method of off shore position finding developed by this survey; survey ships engaged in hydrographic surveying far out to sea, and which measure depths with echo-sounding instruments at the rate of 4 per second while running at full speed; a magnetic observatory for studying the earth's magnetism for use for the mariner's compass and other purposes; and an airplane used extensively in topography as well as flight-checking.

Because of the importance of the nautical chart not only in navigation but in problems of commerce, harbor improvements, etc. a series of six panels was devoted to the steps in the construction of this type of chart to acquaint the visitor with the complexities and detailed work necessary. Shown in this series were a hydrographic sheet, topographic sheet, compilation drawing, printing aluminum sheet, and the finished chart. General photographs of the field and office activities also were displayed.

Some of the surveying instruments used were in a separate case, among them a sextant, plane table, protractor, deep-sea thermometer, collimator, base tape, fathometer, and bench marks. Each object was labeled appropriately.

Enlarged and colored photographs showing field activities completed the exhibit in the Federal Building.

In addition there were on display at the Adler Planetarium and Astronomical Museum three early types of theodolites used in triangulation and azimuth determination, a zenith telescope used in latitude determinations, and a meridian telescope used as an astronomical transit in longitude determinations and as a zenith telescope in latitude determinations. These instruments are part of an historical collection of geodetic instruments dating back to the fifteenth century.

A strong motion seismometer was on display in the Hall of Science, so mounted that the visitor could by simulating earthquake disturbances cause it to start recording. There were displayed also drawings showing the paths of earthquake waves and illustrating the theory of isostasy.



## THE BUREAU OF STANDARDS

The exhibit of the Bureau of Standards was designed to illustrate the wide variety of work performed by the Bureau for the Government and the public in connection with its fundamental duties of constructing, maintaining, and comparing the standards used in science, engineering, industry, and commerce.

The primary standards of length and mass of the United States were illustrated by copies of meter no. 27 and kilogram no. 20, the originals of which are preserved in the standards vault at the Bureau. Examples of the working standards of metrology included several classes of weights, a set of gage blocks, a precision scale graduated in decimeters, a volumetric micrometer for testing dilution pipettes, an internal micrometer for ring gages, a diffraction grating ruled at the Bureau, equipment for measuring thermal expansion, and a flask standard and burette for volumetric testing. An interferometer made visible the bending of a steel rail under the pressure of the hand.

A current balance, which could be operated by visitors, served as an illustration of the Bureau's work in cooperation with other national laboratories on the redetermination of the absolute values of the electrical units.

The testing of clinical thermometers being typical of the Bureau's routine testing, the exhibit included a bath with a standard thermometer in which thermometers were brought to the desired temperature, a reading stand, and a centrifuge for throwing back the mercury.

The use of spectroscopic methods in research and analysis was illustrated by a set of Geissler tubes containing the noble gases in the atmosphere—helium, neon, argon, krypton, and xenon, viewed through a small prism spectroscope.

Progress in atomic physics was illustrated by an electron counter for counting alpha and beta particles. Each flash represented a single atom or electron traveling at the enormous speeds of 6,000 to 100,000 miles per second.

Special equipment developed by the Bureau for accelerated service tests was illustrated by apparatus for the accelerated weathering of paints and by a machine for determining the relative wearing qualities of sole leathers.

Research in aerodynamics was exemplified by a small wind tunnel in which models of an ordinary and a streamlined automobile were mounted in such a way that the relative air resistance of each model was readily apparent.

Methods for determining the strength of structural materials were made clear by the destruction of tensile specimens in an hydraulic testing machine of the latest type and by strain gages and proving rings developed at the Bureau.

An exhibit of metal crystals illustrated the results produced by slowly cooling very pure molten bismuth, the different colored samples showed the result of surface oxidation, similar to the temper colors which develop on heated steel.

The Bureau's work on optical glass was illustrated by samples of various kinds of glass, both satisfactory and unsatisfactory, and by apparatus for determining in a practical way the quality of annealing of lens and prism blanks.

Representative copies of the Bureau's publications showed the manner in which the results of its investigations are made available to the public.

## DEPARTMENT OF LABOR

Labor's progress through the century from the beginning of the machine age to the present day was dramatized in a series of unusual exhibits sponsored by the Department of Labor in the United States Government Building.

The bronze figures of a working man and his family traveling on a spiral track around a modernized glass pyramid was the central feature of the exhibits which were presented in a setting of black and silver.

As the group moved, the tiers of the pyramid were gradually illuminated in colors of the spectrum. The figures stopped just short of the top, and the upper part of the pyramid burst into flame color and revealed on the glass the goals of the future toward which the working man and his family are striving. The goals are these:

"Workers' participation in determining wage and employment policies; earnings adequate for living, saving, and leisure; regular employment, and economic security; health and education, and home life."

On the walls on either side of the pyramid was the following brief history of labor during the past hundred years:

I. After the hard and simple life of pioneer days begins the machine age. Slowly and painfully the working man and woman and their children climb toward security and opportunity. Ignorance and lack of sanitation take many infant lives. Factory wages are low and hours from sunrise to sunset even for little children. Yet free lands in the West help to check abuses and the machine creates new comforts.

II. The western pioneers cherish ideals of independent labor, family life and education. Railroads are built. Immigration increases. Large industries develop. Labor unions are formed but women and children are still exploited. Yet industry brings economic opportunity for women.

III. The machine hastens the growth of cities. Disease and crime flourish in slums. Some laws limit the age of child workers. Union labor wins better hours and wages. Panics occur but new industries restore prosperity. More women and children are employed. The slaves are freed.

IV. State and Federal labor bureaus are established. Compulsory education spreads. Immigration increases. Factory production expands. Wage cuts and strikes are frequent. The Government helps to arbitrate labor disputes. Organized labor gains an 8 hour day and higher wages but most workers are still unorganized.

V. State laws help women and child workers and provide workmen's compensation. Child care improves. Juvenile courts are established. Immigration is restricted. The Department of Labor and the Children's Bureau are created.

VI. The World War speeds up industry and opens new work to women. The Women's Bureau is created. United States conciliators avert strikes. Social legislation makes gains. Wages and prices reach new high levels.



VII. The machine displaces men. Labor's buying power drops. Production decreases. Wage cuts and unemployment destroy standards.

VIII. The struggle continues.

IX. A share in formulating labor policies.

X. Earnings for living, saving, and leisure.

XI. Steady employment. Economic security.

XII. Health and education.

XIII. Home life.

A more literal presentation of the labor history of the century was given in a series of 40 pictures showing changes in working methods and working conditions. These pictures, with brief historical sketches dealing with the industrial development of the century, were reproduced in *Labor Through the Century, 1833-1933*, a booklet (Bul. No. 597) published by the United States Bureau of Labor Statistics for distribution at the Department of Labor exhibit.

Each of the established bureaus of the Department produced its own exhibit in addition to the general departmental display. These individual exhibits dealt both with the historical development of the century in their respective fields and with the work of the exhibiting Bureau.

#### IMMIGRATION BUREAU

A series of pictures showed types of immigrants; the old immigration station at New York City (Castle Garden) and the more modern station at Ellis Island; the examination and selection of applicants for visas in consular offices abroad, a practice which, the picture pointed out "prevents many a heartbreak at Ellis Island"; and the activities of the Immigration Service, such as the patrol of the northern border, picturing immigration inspectors going about their duties on snowshoes. Charts gave statistical data on immigration through the century.

#### NATURALIZATION BUREAU

By means of cartoons, the Bureau of Naturalization achieved an instructive and popular presentation of a subject which would seem difficult to treat as an exhibit. Starting with the naturalization clause of the Constitution engrossed on a scroll, the Bureau developed the steps by which an alien becomes a citizen, and the outstanding changes in naturalization procedure since the Constitution was adopted, such as the granting of citizenship to Negroes. One effective cartoon showed the Cable Act of 1922 handing citizenship in her own right to a married woman standing on the steps of the United States Capitol. Another suggested early abuses of the naturalization laws and the means taken to stop them.

#### CHILDREN'S BUREAU

The Children's Bureau in a series of 12 three-dimensional dioramas depicted the progress of child welfare over the century. Four phases of the welfare of children were presented—health, delinquency, dependency, and child labor—the status of each of which at the beginning, the middle and the close of the century was pictured. The dependent children of 1833, for example, were shown in a grim,

stark orphanage; a scene of a later era showed a trainload of dependent and orphan children at a railroad station in the West being bound out, practically by auction, to farmers and merchants for "their board and keep"; while the third scene, that of the present, was a small dwelling with children playing about in the yard, to suggest the normal home life made possible by State aid to mothers. Prison cells containing delinquent children wearing stripes in the 1833 era gave way to the juvenile courts of the present day. A booklet entitled "*Children's Progress, 1833-1933*", covering the same fields of child welfare and using contemporary pictures of each era, was published by the Children's Bureau for distribution in connection with its exhibit.

#### WOMEN'S BUREAU

Women's work through the century, its shift from the home to the factory, and working conditions in factory and sweatshop, were vividly shown by the Women's Bureau in a series of realistic three-dimensional sets. A typical family group of women—grandmother, mother and daughters—churning, baking, spinning, weaving, and making garments, dramatized the introductory statement that "women have always worked and shared in family support." From the home the scene shifted to the early textile mill, the sweatshop, the tenement workroom, and the munitions factory of the World War period.

Women's part in the early labor movement was depicted by a reproduction of a contemporary picture of the march through the streets of Boston in 1869 of the striking Daughters of St. Crispin, the organized shoe workers who formed the first national trade union for women. The historic incident of a working woman, Sarah Bagley, addressing the Massachusetts Legislature in 1845 in support of the proposed 10-hour law for women and children was also reproduced. The publication, *Women at Work*, which the Women's Bureau published as part of its exhibit, is the story of "a century of industrial change" in the work and the economic status of women.

#### BUREAU OF LABOR STATISTICS

Combining statistical charts and pictured characters suggestive of the nature of the statistical data treated, the Bureau of Labor Statistics made a graphic presentation of productivity of labor, accident and cost-of-living statistics, and other data which it collects and disseminates. These graphic charts, together with text pointing out the value and the practical application of the Bureau's statistical material, have been published by the Bureau of Labor Statistics in a booklet entitled "*What Are Labor Statistics For?*" (Bul. No. 599).

#### HALL OF SOCIAL SCIENCE

In addition to the Department's exhibits in the Federal Building, both the Women's and Children's Bureaus cooperated with the social-service agencies of the country and had exhibits in the Hall of Social Science.



## CHILDREN'S BUREAU

The Children's Bureau exhibit consisted of a very ingenious bureau with revolving drawers. When the drawers opened, attractive cut-outs told of the work of the Bureau in child health, child labor, delinquency, dependency, and social-welfare organization.

The booth itself represented a child's room with windows at each side of the bureau.

A map showing the infant mortality rate, by counties, in color, was part of the exhibit.

## WOMEN'S BUREAU

The Women's Bureau exhibit was prepared and installed at the request of social agencies in the country. Its aim was to show the social program of the Women's Bureau and its part in helping to solve the social and economic problems of wage-earning women that have developed during the century as a result of women's changed economic status.

The exhibit placed on a black base several feet from the floor, consisted of a large modernistic setting of three paneled arches placed one behind the other and graduated in size, the nearest being the largest. At the right and left of the nearest arch were winged panels carrying descriptions of the function and activities of the Women's Bureau in some detail.

The nearest arch in bas-relief and attractive coloring of pale buff, blue, and terra cotta, depicted a characteristic modern exterior scene of our industrial civilization.

The second arch, in silvered metallic effect and also in bas-relief, revealed factory interiors with their intricate mechanism of revolving wheels and conveyors and their employees at monotonous jobs, the whole suggestive of speed and mass production.

On the third arch were painted two industrial communities. The scene on the left showed a ramshackle factory surrounded by slums, carrying the caption, Poor Working Conditions Mean Low Standards of Living. The scene on the right showed a modern up-to-date factory located in an attractive neighborhood with small but well-kept homes, carrying the caption, Good Working Conditions Mean Better Homes and Communities. These two scenes were subdued in effect until illuminated at regular and appropriate intervals.

In the center of this whole setting was an opening at which appeared consecutively and continuously eight illuminated and brilliantly colored posters of the following content:

1. Two contrasting scenes, the one on the left showing a colonial kitchen with women engaged in spinning, sewing, and cooking; the one on the right showing men and women workers in a modern factory; the captions stressing the development of the machine age during the century and the greatly changed methods of production.

2. A crowd of men and women workers pouring out of factory and office buildings, the caption pointing out the increasing need of women to work side by side with men, to earn a livelihood, and to share in family support.

3. A colored, pictorial chart with small figures of men and women representing the numbers in gainful occupations in each census decade from 1870 to 1930, the caption stating that the 11 million women so occupied in 1930 were still greatly outnumbered by men.

4. A pictorial chart of rainbow-colored bars representing the occupational restriction of women in 1930, each main occupation illustrated by a miniature woman worker, the caption stating that women were in all but 30 of the 534 occupations listed by the 1930 census.

5. A figure of a woman worker at a large factory machine against a background showing vignettes of the same woman engaged in a series of household tasks, illustrating the double burden of home duties and paid job carried by the wage-earning home makers.

6. A heroic figure symbolic of the Women's Bureau on a dais holding out a helping hand to another figure of a woman in an industrial setting, representative of employed women, the caption emphasizing the general function of the bureau.

7. The figure of a working woman standing on an arch, bearing a banner with the words, "America will be as strong as her women." The keystone and supporting stones of the arch were labeled with 11 standards recommended by the Women's Bureau for employment of women.

8. The following caption in large gold letters on a vivid blue background: "The Women's Bureau cooperates with agencies, official and private, to improve working conditions and to promote security for individuals and families."

As this caption appeared in the opening the two paintings of good and bad communities to the right and left of the opening were illuminated and remained lighted until the caption disappeared.

## SMITHSONIAN INSTITUTION

The Smithsonian Institution exhibit was located on the second floor in the southeast section of the dome, in an irregular space of approximately 1,100 square feet. In order to conform to the general theme suggested for all Federal exhibits, the Smithsonian exhibit consisted of two distinct parts: (1) a pictorial account of the founding of the Institution and of some of its outstanding achievements in the past, and, (2) a representation, with original material, of some of the current activities of the Institution and its seven branches.

The first, or pictorial, part of the exhibit consisted of nine oil paintings, 40 inches by 30 inches in size, especially prepared by a group of artists, and hung in silver frames on the back walls of the exhibition space. The first of these, entitled "President Jackson Notifies Congress of the Smithsonian Bequest, December 17, 1835", showed President Jackson sitting at his desk in the White House in the act of writing a letter, while his secretary and nephew, Andrew Jackson Donelson, stands in the background waiting to receive the letter. The second painting showed the building of the Smithsonian Institution as completed in 1851, and the third painting was an air view of the portion of The Mall in Washington containing the original building and the three additional ones composing the Smithsonian group today. The six remaining paintings, arranged chronologically, depicted a few of the many activities undertaken "for the increase and diffusion of knowledge among men." The titles of these were:

Prof. Henry Posts Daily Weather Map in the Smithsonian, 1858.

Major Powell Descends the Colorado River Through the Grand Canyon, 1869.

Secretary Langley Tries Out Aerodrome No. 5, 1896.

President Roosevelt Leads Smithsonian African Expedition, 1909-10.

Astrophysical Observatory Established at Montezuma, Chile, 1918.

Division of Radiation and Organisms Established, 1929.



The second part of the exhibit consisted of seven exhibition cases, an exhibit booth, and an automatic lantern slide projector, all distributed over the floor of the space.

In each of the seven cases were arranged a group of original and valuable objects indicative of some current activity of the Institution. The exhibits were:

1. Scientific instruments invented by the Institution and used in solar radiation researches.
2. An oil painting, 2 water colors and 2 porcelain plaques, representing the National Gallery of Art.
3. A variety of live lizards housed in a case modeled to indicate a desert, representing the National Zoological Park.
4. A selected collection of shells of the land mollusk "Cerion", illustrating the results of the progressive experiments in evolution of the Department of Biology of the National Museum.
5. A group of maps and photographs of types of American Indians, representing the researches of the Bureau of American Ethnology.
6. A collection of original carved ivory artifacts consisting of knife handles, trinket boxes, and harpoon points of prehistoric Eskimo cultures, representing current researches of the Department of Anthropology of the National Museum.
7. A collection of trilobite fossils and other paleontological specimens visualizing the many sides of research in paleontology and representing the Department of Geology of the National Museum.

The exhibition booth contained three separate exhibits as follows:

1. Part of the apparatus used in the division of radiation in researches on plant growth.
2. A light spectrum with filters to screen different rays such as used in radiation researches.
3. A group of fluorescent minerals subjected to ultraviolet light with their resultant beautiful coloring.

Lastly, the automatic lantern-slide projector with two series of 70 lantern slides, changed twice a week, revealed present-day scenes in the many workrooms and laboratories of the Institution.

#### NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

Among the outstanding accomplishments of the last century is man's conquest of the air. Since the first flight of the Wright brothers at Kitty Hawk, N.C., December 17, 1903, there have been amazing strides in the development of the airplane as a military weapon and as a mode of rapid transportation. This progress has been due largely to the contributions of the United States Government to the development of the science of aeronautics. Since 1915 the Government has conducted a well-organized program of scientific research in aeronautics, under the jurisdiction of the National Advisory Committee for Aeronautics. It was, therefore, quite fitting that at A Century of Progress Exposition the United States Government should show what it has been doing for the development of a science which has become so vital to our civil and military progress.

The committee exhibited a working display, supplemented by photographs and charts, where the visitor could, by pressing buttons, operate miniature laboratory equipment, thus obtaining practical demonstrations of why an airplane flies, how the stresses are measured

on airplanes in flight, and information as to the investigations being conducted by the committee in its laboratories at Langley Field, Va., for improving the performance, efficiency, and safety of all aircraft.

It is estimated that over 1,000,000 visitors observed these exhibits. So great was the appeal of this working display that the models were kept running for a period equivalent to a continuous operation of 70 percent of the time the building was open. Although it dealt with methods and apparatus used in the conduct of scientific research, this exhibit made an appeal to all classes, partly because of the wide-spread public interest in the subject of aeronautics, but more especially because fundamental principles of the science of aerodynamics were presented and explained in such a way as to attract the interest of the public, as well as of the scientist.

At the entrance to the exhibit there was a glass case containing 4 airplane models depicting the progress of aviation in 30 years. The models were: the original Wright biplane, 1903; a Curtiss JN-4, 1917; a Ryan NYP ("Spirit of St. Louis"), 1927; and the Northrop "Delta", 1933. Each airplane shown was a representative type of the period. This glass case was located on a modernistic base of silver and black, and the committee's name was spelled out in relief letters of blue on the front panel. Over the glass case hung the National Advisory Committee for Aeronautics insignia. This exhibit was backed by a dark blue curtain which provided an appropriate setting for the display.

The  $\frac{1}{48}$ -scale model of the full-scale wind tunnel simulated the operation of the largest and most complete research tunnel in the world. Glass sections of the building and tunnel cone walls allowed the visitor to look into the building and observe its construction and operation in detail. When the operating button was pushed, the main drive motors caused the air to move through the model as it is circulated in the full-scale tunnel. A model airplane, mounted on the balance supports, executed a pitching motion that suggested the control positions through which an airplane might be moved while under test. A model survey arm moved back and forth through the test chamber indicating the action of the survey apparatus for studying the air-flow conditions in all parts of the test chamber. The operating part of the model was electrically timed to run of its own accord for 20 seconds each time the button was pushed. In the test chamber a number of accurately scaled models of people gave the visitor an idea of the size of the actual tunnel. On a large card in front of the model the main features of the full-scale tunnel were described. To operate the tunnel, two 4,000-horsepower electric motors are directly coupled to two 4-blade propellers of 35½ feet in diameter, which circulate the air through the test chamber at controlled velocities up to 120 miles per hour. The entrance cone measures 30 by 60 feet and provides a controlled air stream sufficiently large to accommodate a full-size airplane so that it may be investigated under actual flying conditions.

To many who had never been close to an airplane, and to others who had flown merely as passengers, it was a revelation to see how the control system of an airplane is operated. A working model which gave the visitor an opportunity to manipulate the control stick and the rudder bar seemed to hold a fascination for both old and young. The model airplane was mounted inside a glass case



with part of the pilot's cockpit removed so that the controls were exposed. Outside the case, within convenient reach, were located a control stick and rudder bar. A descriptive card explained how the pilot moves these controls to cause an airplane to dive, to climb, to bank, and to turn. When the visitor moved the controls outside the case, the controls in the pilot's cockpit moved correspondingly and the control surfaces of the model airplane moved as they would in a full-size airplane. A current of air was kept constantly flowing past the wings and the propeller was kept continuously rotating.

A working model, demonstrating why an airplane flies, showed that the flow of air past the wing of an airplane creates a suction lift on the upper surface of the wing and a positive pressure upward on the under surface of the wing. It also indicated the variation of the lifting force along the line of flow of the air from front to rear of the wing. Along this line were 5 holes on the top surface of the wing, and 5 on the under surface, connected by tubes to a manometer. When the visitor pushed down the operating lever, a current of air was sent past the airplane model at high speed. The airplane model was adjusted to a climbing position with respect to the direction of the air flow. The difference in air pressure at each of 10 holes was instantly registered on the manometer, the fluid in the 5 tubes leading to the holes in the upper surfaces of the wing being drawn upward and the fluid in the 5 tubes leading to the holes in the under surfaces being pressed downward. The magnitude of the suction or pressure varied with the location of each hole on the wing, thus showing how the air pressure and lift is distributed over the wing of an airplane in flight, and showing further that the major portion, approximately 60 percent, of the weight of an airplane is sustained by a section on the upper surface of the wing.

In the actual conduct of pressure-distribution researches there may be hundreds of such holes in the surfaces of an airplane, including its control surfaces, and a multiple manometer is used which automatically records the continuous variation in pressure over each hole in the surface while the aircraft is in steady flight or going through maneuvers. It is particularly important to know what the stresses are on the structure of an airplane when it is going through violent maneuvers, such as a nose dive, reverse turn, loop, etc. This means of ascertaining the distribution of the stresses on aircraft in flight was first devised in the United States.

The  $\frac{1}{12}$ -scale working model of the committee's vertical wind tunnel showed the method used for investigating the spinning characteristics of airplanes. To investigate these characteristics it is necessary to have an air stream moving either up or down past the model being tested. Then the operating button of the model tunnel was pushed, the air was circulated vertically downward through the test chamber, and the model airplane, mounted in a spinning attitude on its recovering dynamometer, executed a slow spinning motion. Streamers on the wing tips indicated the direction of air flow, and scale figures of men recording data added to the realism of the demonstration. Realizing the danger resulting from unintentional and uncontrolled spins, the committee has conducted extensive researches to investigate the causes for spins so as to eliminate this hazard from flying.

In flight there is actually no so-called "air pocket" or vacuum, but in gusty weather an airplane flies into up and down currents of air which cause it to rise or fall abruptly. The National Advisory Committee for Aeronautics has developed methods for measuring the forces thus suddenly applied which enable airplane designers to provide a sufficient safety factor. The setting for this working model showed a landscape painting arranged like a diorama with a river flowing through the center. When the button was pushed a model airplane moved across the "sky" as though flying at about 1,000-foot altitude. As the airplane approached the river it dropped in its flight path without diving, and a little farther on, it rose again without climbing. The drop in the flight path was represented as being due to a downward gust of air caused by the cooling effect of the water, and the rise in the flight path was suggested as being caused by an upward gust of air from a hot, arid region. This model gave two demonstrations of an airplane flying through this flight path. As the first airplane moved across the field, a screen was lighted directly over the airplane showing an enlarged wing section and the pressure diagram for the condition of level flight. As the airplane entered the down-gust region, another screen was lighted over the airplane showing the pressure distribution over the wing for this condition. Another diagram was shown as the airplane encountered the upward gust and also for level flight at the end of its path. After the visitor had had a short time to study these diagrams, the lights were extinguished and a recording dial was illuminated below. The second model airplane moved through this flight path as had the first one, and the indicating hand moved to show the load forces on the airplane as it was subjected to down and up gusts of air. The dial showed the force of the bumps, as load factors; that is to say, if the airplane weighed 3,000 pounds and the recorder indicated two, the wing structure must be strong enough to support at that instant twice the weight of the airplane, or 6,000 pounds, distributed in the manner indicated by the pressure diagrams.

The working model demonstrating how airfoil in front of the wing decreases safety, consisted of a ground-glass screen behind which a wing profile was lighted when the operating button was pushed. Light dots moving across the screen in line formation simulated air flowing past the wing section. For 10 seconds the wing held a normal angle with respect to the air flow and the flow conditions were shown as smooth and regular. The wing then moved down to the trailing edge and presented a steep, climbing angle to the direction of the air flow. This condition represented a stall in which there was a loss of lift and stability and the air-flow lines showed considerable turbulence above and to the rear of the wing. After this position had been held for 10 seconds, a small auxiliary wing had moved to its position, the air-flow lines were pulled down over the main wing, showing how the air flow was improved so as to give increased lift and to restore stability.

To increase the efficiency and safety of aircraft, the committee has conducted much research on fuel-injection engines. A model showed in cross section four types of combustion chambers used by the committee's engine laboratories for investigations with fuel-injection engines. The combustion spaces were represented by ground-glass screens; when the button was pushed, flowing light lines were projected



on these screens to simulate the injection of fuel. The type of fuel spray used for each type of combustion space was clearly shown.

A working model gave a slow-motion demonstration of the apparatus designed by the committee for studying the injection of fuel and the combustion in an engine cylinder. The test cylinder has glass windows through which by the aid of high-speed photographic equipment the events occurring in the cylinder are recorded. The operating button started an engine piston, connecting rod, and crank in motion in front of a cross-section of the combustion engine. The cylinder and its combustion space were represented by a ground-glass screen, and as the piston approached top center a fuel-spray image was projected on the screen. The fuel spray appeared to develop, as though the fuel valve were injecting fuel, and before it had extended the full distance it appeared to glow at various points, suggesting the start of burning. This glow increased and appeared to tear the fuel spray apart as it rapidly filled the entire combustion chamber and cylinder with a turbulent flaming mass of burning gases. At the bottom of the piston stroke the exhaust ports were uncovered and the burning died down as the gases were exhausted. At the start of the up stroke, the burning ceased and the piston proceeded as with the compression of a new charge of air. The photographing procedure was simulated at the combustion-chamber level by a reflector that directed the light from a high-voltage spark, suggested by a flashing light, through the glass windows of the combustion chamber, through a lens, and on to a revolving film drum. The film drum carried a photographic record that showed two frames with development of the fuel spray, one frame showing some spray outline, and the start of combustion, and a continuation of the light image caused by combustion. The light flashes and the position of the film drum were timed so that the events appeared to be photographed from the combustion chamber.

A working model 22 feet long of a tank, was built to a scale of one half inch to 1 foot in all respects except as to length. To have shown the length in true proportion would have required a model 93 feet long. The tank, filled with water, was enclosed in a glass case with indirect lighting illuminating a cut-away section of the building. On the sides of the tank were two rails upon which rested a towing carriage made of tubular framework and carrying three sets of scales. The scales were connected to a framework attached to a model seaplane hull which rested on the surface of the water. When the operating button was pushed, the carriage moved down the tank and towed the model seaplane hull along the surface of the water as though it were conducting a test. At the end of its run the carriage automatically stopped and returned to its starting point ready for another demonstration. Inside and around the building were arranged figures of men and float models to add a touch of realism to the model. The real National Advisory Committee for Aeronautics tank is 2,040 feet long, 24 feet wide, and 12 feet deep, and seaplane hulls and floats can be towed at speeds up to 60 miles per hour.

In back of the tank model, and hanging against the partition, were arranged 10 large photographs showing high spots of National Advisory Committee for Aeronautics activities. Above the partition was hung an enlarged photograph of the group attending the last

Aircraft Manufacturers' Conference at the Committee's laboratories at Langley Field, Va., on May 4, 1933.

Visitors desiring more information concerning the National Advisory Committee for Aeronautics researches could enter the space behind the models, where a multiplex display stand showed 24 charts covering detailed investigations conducted by the Committee. Here the charts could be studied at length. If a visitor showed unusual interest in the exhibit material or the charts, he was approached by an attendant from the National Advisory Committee for Aeronautics, who offered him a pamphlet describing the activities of the Committee and its researches. If the visitor desired, he could enter the inside space, sit down, and discuss matters with the Committee's representative on duty.

The exhibit of the National Advisory Committee for Aeronautics in the mathematics section, of the Hall of Science, was located in booth no. 19, main hall, mezzanine balcony. This exhibit consisted of a model of the variable-density wind tunnel, a model of the propeller-research tunnel, and two wall charts describing detailed investigations in the actual wind tunnels.

The one twenty-fourth scale working model of the variable-density wind tunnel, inclosed in a glass case, was constructed with glass side sections to permit visitors to see the inside and working parts of the tunnel. When the operating button was pushed, the test chamber was illuminated and the drive motor operated to circulate air through the model as it does in the actual tunnel. The variable-density wind tunnel allows tests to be made with scale models under a heavy air pressure that gives results equivalent to full-scale operation. When, for example, a model one twentieth the size of an airplane is tested, the air in the tunnel is compressed to 20 times its normal density, or to 300 pounds per square inch. In the determination of the lift and drag characteristics of wing sections, the results obtained with this equipment are accepted as standard.

There was also a one forty-eighth scale working model of the wind tunnel that is used for conducting research on full-scale propellers. Glass sections in the building and indirect inside lighting enabled the visitor to observe the direction of the air flow as indicated by streamers when the operating button was pushed.

Prior to the construction of the propeller-research tunnel in 1926, the design of airplane propellers was dependent upon model tests and tests in flight. Wind-tunnel tests on small-model propellers had shown the necessity for a full-sized propeller-research tunnel in order to obtain more accurate fundamental data to permit of the accurate design of more efficient propellers.

This equipment has also been used to investigate the cowling and cooling of air-cooled engines, with resulting great increase in airplane efficiency through the use of the National Advisory Committee for Aeronautics cowling and the National Advisory Committee for Aeronautics engine-propeller location.

## THE NATIONAL CAPITAL PARK AND PLANNING COMMISSION

The National Capital Park and Planning Commission was appointed by Congress and charged with the preparation of a compre-